CLAIMS

What is claimed is:

1. A method of applying viscous material to at least one semiconductor element, said method comprising:

providing a receptacle including at least one viscous material pool containing viscous material having an exposed surface extending upwardly to a height therein, said at least one viscous material pool including at least one opening to provide access to at least said exposed surface of said viscous material;

providing at least one stop proximate said receptacle;

controlling the height of said exposed surface of said viscous material; and

placing at least one semiconductor element against said at least one stop such that only a specific portion of said at least one semiconductor element contacts said exposed surface of said viscous material.

2. The method according to claim 1, wherein said providing a receptacle including at least one viscous material pool containing viscous material comprises providing at least one viscous material pool containing adhesive or polyimide.

3. The method according to claim 2, wherein said providing a reservoir including at least one viscous material pool containing viscous material comprises providing a viscous material pool containing adhesive selected from the group consisting of thermoplastics, thermoset resins, flowable pastes, and B-stage adhesive materials.

4. The method according to claim 1, wherein said placing at least one semiconductor element against said at least one stop comprises extending said specific location of said at least one semiconductor element beyond a top surface of the exposed surface of said viscous material.

5. The method according to claim 4, wherein said extending comprises immersing said specific location of said at least one semiconductor element beyond said top surface of the

exposed surface of said viscous material for a time sufficient to allow the viscous material to wet said specific location of said at least one semiconductor element.

6. The method according to claim 5, wherein said extending comprises immersing said specific location of said at least one semiconductor element beyond said top surface of the exposed surface of said viscous material for approximately 10 to 25 milliseconds.

7. The method according to claim 1, wherein said placing said at least one semiconductor element against said at least one stop comprises extending said specific location of said at least one semiconductor element beyond a top surface of the exposed surface of said viscous material without breaking the surface tension of said viscous material.

8. The method according to claim 1, wherein said providing a receptacle comprises providing a receptacle shaped such that the exposed surface of the viscous material is presented in a precise location and configuration.

9. The method according to claim 1, wherein said placing at least one semiconductor element comprises placing at least one of a lead finger, carrier substrate, bond pad and trace pad above said at least one opening.

10. The method according to claim 1, wherein said placing comprises aligning said at least one semiconductor element above said at least one opening.

11. The method according to claim 1, wherein said placing comprises biasing said at least one semiconductor element downward proximate the viscous material.

12. The method according to claim 11, wherein said biasing comprises providing at least one a hydraulic biasing mechanism, pneumatic biasing mechanism, and electrically-powered

biasing mechanism configured to place said at least one semiconductor element proximate said viscous material.

13. The method according to claim 1, wherein said placing comprising raising said at least one viscous material pool upward proximate said at least one semiconductor element.

14. The method according to claim 1, wherein said controlling comprises pumping said viscous material into said at least one viscous material pool.

15. The method according to claim 1, further comprising pumping said viscous material to a height above said at least one stop sufficient to contact said specific location of said at least one semiconductor element.

16. The method according to claim 15, wherein said pumping comprises creating a moving wave of said viscous material traveling across said at least one viscous material pool.

17. The method according to claim 1, wherein said placing comprises applying a layer of viscous material having a thickness between 0.1 to 15 mils on said specific location of said at least one semiconductor component.

18. The method according to claim 1, further comprising coating at least said specific location of the at least one semiconductor element with a surfactant prior to placing said at least one semiconductor element against said at least one stop.

19. The method according to claim 1, further comprising adding an adhesion promoter to said viscous material, wherein said adhesion promoter is selected from the group consisting of silane, siloxane, and polyimide siloxane.

20. The method according to claim 1, wherein said controlling the height of the exposed surface of said viscous material comprises leveling said exposed surface.

21. The method according to claim 20, wherein said leveling comprises:
providing said viscous material to said at least one viscous material pool such that said exposed surface of said viscous material reaches an initial exposed surface height higher than a desired exposed surface height; and
flattening said initial exposed surface height to the desired exposed surface height.

22. The method according to claim 21, wherein said flattening comprises metering said initial exposed surface height with a wiper.

23. The method according to claim 21, wherein said providing said viscous material comprises pumping said viscous material into said at least one viscous material pool.

24. The method according to claim 21, wherein said flattening said initial exposed surface height comprises drawing back said viscous material to flatten said exposed surface of said viscous material.

25. The method according to claim 1, wherein said controlling the height of said exposed surface of said viscous material comprises employing a detection mechanism.

26. The method according to claim 25, wherein said controlling the height of said exposed surface of said viscous material comprises:
delivering said viscous material to said viscous material pool;
providing said detection mechanism comprising a transmitter, a receiver, and a control signal;
determining the height of said exposed surface with said transmitter and said receiver;
generating said control signal to control delivery of said viscous material to said at least one viscous material pool.

27. The method according to claim 26, wherein said generating said control signal comprises triggering a pump to stop delivering said viscous material to said at least one viscous material pool when a desired height of said exposed surface is achieved.

28. The method according to claim 26, wherein said generating said control signal comprises triggering a valve to shut to prevent said viscous material from entering said at least one viscous material pool.

29. The method according to claim 25, wherein said employing a detection mechanism comprises providing a laser transmitter, wherein a light beam from said transmitter is altered by the exposed surface and wherein a receiver detects the alteration of said light beam and then generates a control signal.

30. The method according to claim 25, wherein said employing a detection mechanism comprises providing an ultrasonic transmitter, wherein an ultrasonic sound wave from the transmitter is altered by the exposed surface and wherein a receiver detects the alteration in the ultrasonic sound wave and then generates the control signal.

31. The method according to claim 1, wherein said controlling comprises providing a coating stencil proximate an upper surface of said receptacle, said coating stencil including:
a generally flat and generally horizontal top surface; and
a plurality of apertures aligned to apply said viscous material to said specific location of said at least one semiconductor element, said plurality of apertures sized and configured to control extrusion of said viscous material through said coating stencil to increase the exposed surface of said viscous material.

32. The method according to claim 31, wherein said providing a coating stencil comprises providing said coating stencil wherein the plurality of apertures are substantially rectangular in shape.

33. The method according to claim 31, wherein said providing a coating stencil comprises providing said coating stencil wherein the plurality of apertures of said coating stencil are substantially square in shape.

34. The method according to claim 31, wherein said providing a coating stencil comprises sizing and configuring said plurality of apertures of said coating stencil as a result of considering a viscosity of said viscous material.

35. The method according to claim 34, wherein said providing a coating stencil comprises sizing and configuring said plurality of apertures of said coating stencil to suit a viscous material viscosity ranging from approximately 1000 to 500,000 centipoise.

36. The method according to claim 34, wherein said providing a coating stencil comprises sizing and configuring the plurality of apertures of said coating stencil to optimally accommodate a viscous material viscosity of approximately 62,000 centipoise.

37. The method according to claim 34, wherein said providing a coating stencil comprises sizing and configuring the plurality of apertures of said coating stencil to optimally accommodate a viscous material viscosity of approximately 62,000 centipoise at a temperature of approximately 77° F (25 °C).

38. The method according to claim 31, wherein said providing a coating stencil comprises arranging the plurality of apertures of said coating stencil generally parallel to each other and are spaced so as to have a centerline pitch between apertures of .020 inches (.051 cm).

39. The method according to claim 31, wherein said providing a coating stencil comprises providing a coating stencil having 23 apertures.

40. The method according to claim 31, wherein said providing a coating stencil comprises sizing the plurality of apertures of said coating stencil to be .260 inches (.660 cm) in length and .010 inches (.025 cm) in width.

41. The method according to claim 31, further comprising providing a vacuum on a bottom side of said coating stencil.

42. The method according to claim 1, further comprising providing a circulation mechanism configured to circulate said viscous material and maintain uniformity of said viscous material.

43. The method according to claim 1, wherein said providing a receptacle comprises providing a receptacle including a housing having an inflow chamber in fluid communication with said at least one viscous material pool.

44. The method according to claim 1, further comprising adjusting said at least one stop to a desired height.

45. The method according to claim 1, wherein said providing at least one stop comprises providing a buoyant stop independent from said reservoir.

46. The method according to claim 45, wherein said placing at least one semiconductor element against said at least one stop comprises pressing said at least one semiconductor down on the buoyant stop to displace said viscous material upward toward said specific portion of said at least one semiconductor element.

47. The method according to claim 46, further comprising providing a mechanism to press said at least one semiconductor element against said at least one stop and a pressure sensor

associated with said buoyant stop, wherein said pressure sensor triggers the mechanism to stop pressing when a predetermined pressure is attained.

48. A method of applying viscous material to at least one semiconductor element, said method comprising:

providing a receptacle including at least one viscous material pool containing viscous material having an exposed surface extending upwardly to a height therein, said at least one viscous material pool including at least one outlet to present at least said exposed surface of said viscous material;

providing at least one stop proximate said receptacle;

extruding said viscous material through a coating stencil to reveal said exposed surface; and

positioning at least one semiconductor element proximate said at least one stop such that only a specific portion of said at least one semiconductor element contacts said exposed surface of said viscous material.

49. The method according to claim 48, wherein said providing a receptacle including at least one viscous material pool containing viscous material comprises providing at least one viscous material pool containing adhesive or polyimide.

50. The method according to claim 49, wherein said providing at least one viscous material pool containing viscous material comprises providing a viscous material pool containing adhesive selected from the group consisting of thermoplastics, thermoset resins, flowable pastes, and B-stage adhesive materials.

51. The method according to claim 49, wherein said positioning at least one semiconductor element proximate said at least one stop comprises extending said specific location of said at least one semiconductor element beyond a top surface of the exposed surface of said viscous material.

52. The method according to claim 51, wherein said extending comprises immersing said specific location of said at least one semiconductor element beyond said top surface of the exposed surface of said viscous material for a time sufficient to allow the viscous material to wet said specific location of said at least one semiconductor element.

53. The method according to claim 52, wherein said extending comprises immersing said specific location of said at least one semiconductor element beyond said top surface of the exposed surface of said viscous material for approximately 10 to 25 milliseconds.

54. The method according to claim 48, wherein said positioning said at least one semiconductor element proximate said at least one stop comprises extending said specific location of said at least one semiconductor element beyond a top surface of the exposed surface of said viscous material without breaking the surface tension of said viscous material.

55. The method according to claim 48, wherein said providing a receptacle comprises providing a receptacle shaped such that the exposed surface of the viscous material is presented in a precise location and configuration.

56. The method according to claim 48, wherein said positioning at least one semiconductor element comprises positioning at least one of a lead finger, carrier substrate, bond pad and trace pad above said at least one opening.

57. The method according to claim 48, wherein said positioning comprises aligning said at least one semiconductor element above said at least one opening.

58. The method according to claim 1, wherein said positioning comprises biasing said at least one semiconductor element downward proximate the viscous material.

59. The method according to claim 58, wherein said biasing comprises providing at least one a hydraulic biasing mechanism, pneumatic biasing mechanism, and electrically-powered biasing mechanism configured to place said at least one semiconductor element proximate said at least one stop.

60. The method according to claim 58, wherein said positioning comprises raising said at least one viscous material pool upward proximate said at least one semiconductor element.

61. The method according to claim 48, further comprising pumping said viscous material into said at least one viscous material pool.

62. The method according to claim 48, wherein said extruding comprises pumping said viscous material through said coating stencil to a height above said at least one stop sufficient to contact said specific location of said at least one semiconductor element.

63. The method according to claim 48, wherein said positioning comprises applying a layer of viscous material having a thickness between 0.1 to 15 mils on said specific location of said at least one semiconductor component.

64. The method according to claim 48, further comprising coating at least said specific location of the at least one semiconductor element with a surfactant prior to positioning said at least one semiconductor element proximate said at least one stop.

65. The method according to claim 48, further comprising adding an adhesion promoter to said viscous material, wherein said adhesion promoter is selected from the group consisting of silane, siloxane, and polyimide siloxane.

66. The method according to claim 48, wherein said extruding comprises leveling said exposed surface.

67. The method according to claim 48, further comprising controlling the height of said exposed surface of said viscous material by employing a detection mechanism.

68. The method according to claim 67, wherein said controlling the height of said exposed surface of said viscous material comprises:
delivering said viscous material to said viscous material pool;
providing said detection mechanism comprising a transmitter, a receiver, and a control signal;
determining the height of said exposed surface with said transmitter and said receiver;
generating said control signal to control delivery of said viscous material to said at least one viscous material pool.

69. The method according to claim 68, wherein said generating said control signal comprises triggering a pump to stop delivering said viscous material to said at least one viscous material pool when a desired height of said exposed surface is achieved.

70. The method according to claim 68, wherein said generating said control signal comprises triggering a valve to shut to prevent said viscous material from entering said at least one viscous material pool.

71. The method according to claim 68, wherein said providing a detection mechanism comprises providing a laser transmitter, wherein a light beam from said transmitter is altered by the exposed surface and wherein the receiver detects the alteration of said light beam and then generates a control signal.

72. The method according to claim 68, wherein said providing a detection mechanism comprises providing an ultrasonic transmitter, wherein an ultrasonic sound wave from the transmitter is altered by the exposed surface and wherein the receiver detects the alteration in the ultrasonic sound wave and then generates the control signal.

73. The method according to claim 48, wherein said extruding said viscous material through a coating stencil to reveal said exposed surface comprises providing a coating stencil including:

a generally planar horizontal top surface; and

a plurality of apertures aligned to apply said viscous material to said specific location of said at least one semiconductor element, said plurality of apertures sized and configured to control extrusion of said viscous material through said coating stencil to increase the exposed surface of said viscous material.

74. The method according to claim 73, wherein said providing a coating stencil comprises providing a coating stencil wherein the plurality of apertures are substantially rectangular in shape.

75. The method according to claim 73, wherein said providing a coating stencil comprises providing a coating stencil wherein the plurality of apertures of said coating stencil are substantially square in shape.

76. The method according to claim 73, wherein said providing a coating stencil comprises sizing and configuring said plurality of apertures of said coating stencil as a result of considering viscosity of said viscous material.

77. The method according to claim 76, wherein said providing a coating stencil comprises sizing and configuring said plurality of apertures of said coating stencil to suit a viscous material viscosity ranging from approximately 1000 to 500,000 centipoise.

78. The method according to claim 76, wherein said providing a coating stencil comprises sizing and configuring the plurality of apertures of said coating stencil to optimally accommodate a viscous material viscosity of approximately 62,000 centipoise.

77. The method according to claim 76, wherein said providing a coating stencil comprises sizing and configuring the plurality of apertures of said coating stencil to optimally accommodate a viscous material viscosity of approximately 62,000 centipoise at a temperature of approximately 77° F (25 °C).

78. The method according to claim 73, wherein said providing a coating stencil comprises arranging the plurality of apertures of said coating stencil generally parallel to each other and are spaced so as to have a centerline pitch between apertures of .020 inches (.051 cm).

79. The method according to claim 73, wherein said providing a coating stencil comprises providing a coating stencil having 23 apertures.

80. The method according to claim 73, wherein said providing a coating stencil comprises sizing the plurality of apertures of said coating stencil to be .260 inches (.660 cm) in length and .010 inches (.025 cm) in width.

81. The method according to claim 48, further comprising providing a vacuum on a bottom side of said coating stencil.

82. The method according to claim 48, further comprising providing a circulation mechanism configured to circulate said viscous material and maintain uniformity of said viscous material.

83. The method according to claim 48, wherein said providing a receptacle comprises providing said receptacle including a housing having an inflow chamber in fluid communication with said at least one viscous material pool.

84. The method according to claim 48, further comprising adjusting said at least one stop to a desired height.

85. The method according to claim 48, wherein said providing at least one stop comprises providing a buoyant stop independent from said reservoir.

86. The method according to claim 85, wherein said positioning at least one semiconductor element proximate said at least one stop comprises pressing said at least one semiconductor down on the buoyant stop to displace said viscous material upward toward said specific portion of said at least one semiconductor element.

87. The method according to claim 86, further comprising providing a mechanism to press said at least one semiconductor element against said at least one stop and a pressure sensor associated with said buoyant stop, wherein said pressure sensor triggers the mechanism to stop pressing when a predetermined pressure is attained.